Technical endovascular highlights for crossing the difficult aortic bifurcation

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Effective endovascular treatment requires successful vascular access to reach the targeted lesion. When the targeted lesion is infrainguinal in location, the vascular access options include the ipsilateral antegrade femoral approach, the contralateral retrograde femoral approach, or the transbrachial approach. The contralateral retrograde femoral route remains the most commonly used approach but may be challenging, particularly in the settings of a scarred groin or a difficult aortic bifurcation. The purpose of this article is to provide technical tips for the challenges encountered in obtaining contralateral femoral access for peripheral interventions with a difficult aortic bifurcation. (J Vasc Surg 2011;54:893-6.)

Effective endovascular treatment requires successful vascular access to reach the targeted lesion. When the targeted lesion is infrainguinal in location, the vascular access options include the ipsilateral antegrade femoral approach, the contralateral (CL) retrograde femoral approach, or the transbrachial approach. The common femoral artery (CFA) is the most frequently used of all the percutaneous arterial access sites[1] because of its anatomy (it is very consistent in location), its accessibility (it is superficial), its size (it is a large vessel), and the ease of puncture site control (the femoral artery can be compressed against the femoral head). To treat infrainguinal arterial disease from a contralateral approach, one must successfully cross the aortic bifurcation. Certain features resulting from native aortic anatomy or from prior endovascular or open aortic procedures can make crossing the aortic bifurcation difficult. The most common conditions that create a fixed, narrow aortic bifurcation angle are (1) heavy, concentric calcification of the native aortoiliac vessels; (2) prior aortoiliac or aortofemoral bypass; (3) kissing iliac stents or stent grafts extending into the distal aorta; and (4) prior bifurcated aortic stent graft. The purpose of this article is to provide technical tips for the challenges encountered in obtaining contralateral femoral access for peripheral interventions, with particular focus on access through a scarred groin and on successfully crossing of a difficult aortic bifurcation.

BASIC TECHNIQUES

We always prepare and drape both groin regions so that both femoral arteries are accessible within the operative field. After assessing the CL femoral artery (in this setting, *contralateral* means the side opposite to the leg that is the target of intervention) by palpation, ultrasound imaging, or both, the artery is punctured using either a micropuncture needle or an 18G needle. Fluoroscopy and/or ultrasound imaging is used to ensure the CFA is punctured—not the superficial (SFA) or profunda femoral artery (PFA)—at the level of the femoral head. Using the Seldinger technique, once an 11-cm sheath (5-7 French; Cordis Corporation, Miami, Fla) is inserted over the wire, a 0.035" floppy angled Glidewire (Terumo, Somerset, NJ) is ultimately passed retrograde through the sheath, up the contralateral iliofemoral system, and positioned in the aorta. The patient is then anticoagulated with a bolus of unfractionated heparin (100 units/kg), unless only a diagnostic procedure is planned. If difficulty is encountered advancing the Glidewire to the level of the aorta because of tortuosity or stenosis, we use a 40-cm-long, 5 Fr Berenstain catheter (Angiodynamics, Inc, Queensbury, NY) to direct the Glidewire into the aorta. Once the Glidewire has reached the aorta, a 4 Fr RIM catheter (Cook Inc, Bloomington, Ind) is inserted over the wire and positioned just above the level of the aortic bifurcation. Withdrawing the wire into the RIM catheter allows it to reform in the distal aorta, where it is oriented to point toward the ipsilateral (IL) leg. If the bifurcation angle is too tight to use the RIM catheter, either an SOS or Omni flush catheter (AngioDynamics) are good alternative catheters.

Once a sufficient length of the Glidewire is advanced into the ipsilateral iliac artery—usually down to the level of the CFA—the catheter is also advanced over the wire to the level of the CFA. Because of the tight curve in the RIM catheter and the complex curves in the SOS or Omni flush catheters, they might not track over the wire. If the catheter used to direct the wire into the CL iliofemoral system cannot be advanced over the wire, then a catheter exchange is performed, usually substituting an angled glide catheter (Terumo). Once this catheter is advanced to the level of the distal external iliac artery or CFA, a selective lower extremity angiogram is then performed. After completing the angiogram, the Glidewire is reinserted through the catheter and directed into either the SFA, PFA, or bypass graft (if present). The Glidewire is then removed and a stiff wire—either a stiff Glidewire (Terumo), Rosen wire (Cook Inc), or Amplatz wire (Boston Scientific, Natick, Mass) are

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placed into one of the IL leg arteries. The short sheath originally placed in the CL CFA is now removed, with manual compression of the puncture site. A long sheath, usually a 55-cm Raabe sheath (Cook Inc) is then advanced over the wire, across the aortic bifurcation either to the CFA or into one of the IL leg arteries. Another sheath option is the 55-cm, Ansel 1 sheath (Cook Inc) or the 45-cm Balkin sheath (Cook Inc). We prefer to use long sheaths that are braided (as supposed to nonbraided) in order to decrease the tendency to kink while crossing the aortic bifurcation, particularly if it is tight or heavily calcified. It is important to use wires that are 260 cm in length for CL access, in order to have sufficient working length for the intended procedure in the leg needing treatment.

ADVANCED TECHNIQUES

The scarred groin access site

The scarred groin usually does not create difficulty in puncturing the artery but in tracking a sheath over the initial wire placed through the puncture needle. If the groin has been accessed on multiple occasions or if there has been a prior open operative procedure in the groin, it is best to anticipate difficulty with sheath insertion. To avoid unsuccessful sheath insertion, the first step is to insert a short 75-cm Amplatz wire (Cook Inc) through the puncture needle (taking care to avoid injury to the femoral or iliac artery while advancing this stiff wire). Once this wire is in place, the puncture needle can be removed, and then the tract should be dilated, using sequentially larger dilators, beginning with a 4 Fr dilator and progressing to at least a 6 Fr or even 7 Fr dilator (Cordis Corporation).

The narrow-angle, fixed aortic bifurcation

The catheter that will not track. One of the first problems encountered in crossing a difficult aortic bifurcation is failure of the catheter to track over the wire when the bifurcation angle is acute. The catheter will commonly "jump" or push up into the aorta, taking the wire with it. In other words, the catheter will not engage the aortic bifurcation (Fig 1). If this happens, a few variations of the basic technique may help (Table). First, if the wire can be advanced into the IL CFA, one may be able to exchange the catheter used to direct the wire into the IL iliofemoral system for a catheter without any complex or tight curves, such as a Glide catheter (4 or 5 Fr; Terumo, Tokyo, Japan), a Slip-Cath (Cook Inc), a vertebral catheter, a shuttle select JB-1 catheter (Cook Inc), or a Quick Cross catheter (Spectranetics Corporation, Colorado Springs, Calif). Each of these is a straight or simple curve catheter that tracks more easily than a catheter with tight or complex curves. Once an alternative catheter has been advanced into the IL CFA, the Glidewire can be exchanged for a stiffer wire, such as a stiff Glidewire, or a Rosen, Amplatz, Meier, Lunderquist or Advantage wire. Prior to exchanging the initial guide wire for a stiffer wire, it is important to advance the floppy guide wire as far into the SFA, PFA, or bypass graft as possible, in order to have maximal wire support while advancing the sheath across the aortic bifurcation. Another approach to the narrow-angle aortic bifurcation is to use a deformable catheter, such as the Morph catheter (Biocardia, South San Francisco, CA) to direct the wire into the IL iliac artery.

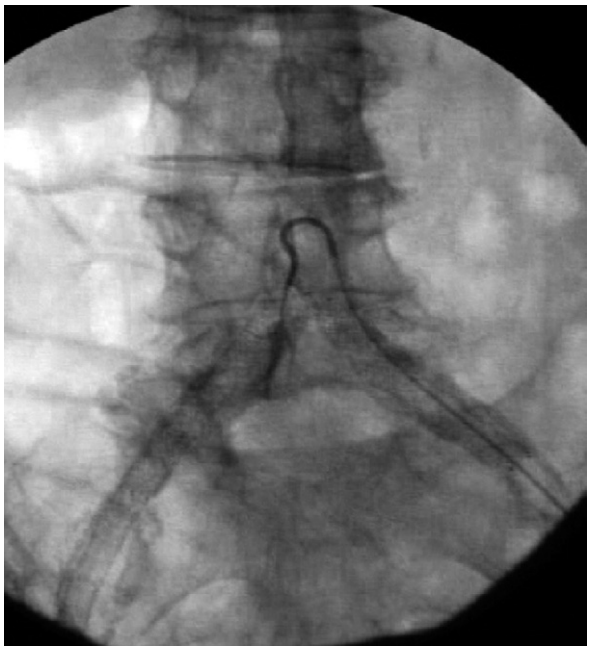

Fig 1. Failure of the catheter to engage the aortic bifurcation.

The sheath that will not track. While one can almost always successfully direct a wire into the IL leg from the CL groin, and successfully track a catheter over that wire, it is much more problematic to get a sheath to track over a fixed, narrow-angle aortic bifurcation. In fact, in many circumstances, it will not be possible, and if one can actually track the sheath, the aortic angle may create such a kink in the sheath that it will be impossible to advance or deploy any devices through the sheath. This is particularly likely when trying to advance a sheath over the bifurcation of an aortic graft, whether it is a stent graft or a graft placed during an open operation. One should anticipate in either of those circumstances that a brachial approach will likely be necessary. However, if the patient has previously placed iliac stents or a calcified aortoiliac bifurcation, it may be possible to successfully track a sheath across the aortic bifurcation using the techniques described below (Table).

Step # 1: Rapidly advancing and withdrawing the wire. We first try to rapidly advance and withdraw ("wiggle") the stiff Glidewire in order to move the sheath more easily, a maneuver that seems to remove tension in passing the sheath (Fig 2).

Step # 2: Using a stiff wire. The sheath is more likely to advance over the aortic bifurcation if the angle can be made less acute. One way to reduce the angle of the aortic bifurcation ("open" it) is to place a stiff wire through the catheter, once the catheter has successfully been advanced

Table. Technical challenges and suggestions for the aortic bifurcation

Challenge	*Suggestion*
Scarred groin	1. Amplatz stiff wire with upscaling (4 Fr to 6 Fr) dilators
Difficulty engaging the aortic bifurcation	1. Slip, Glide, or Quick Cross catheters over a stiff wire 2. Morph catheter
When the sheath does not track	1. Stiffer wire 2. Advance the sheath over the dilator 3. Advance the sheath over an inflated balloon 4. Snaring technique

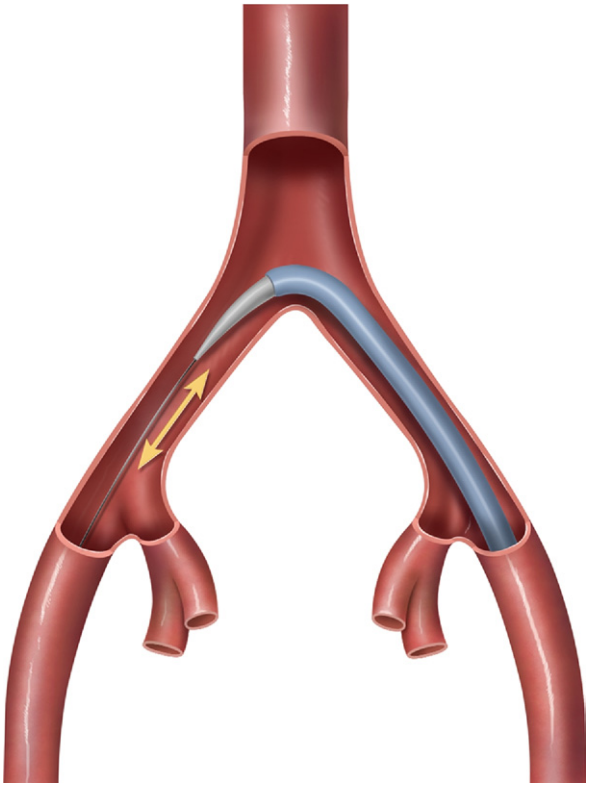

Fig 2. Rapid advancement and withdrawal of the wire.

over the initial floppy wire, well into one of the arteries in the IL leg. An Amplatz wire is often used for this purpose, and one can actually see the aortic bifurcation splay out while advancing this wire across the aortic bifurcation. This gives rigidity to the system and usually allows the sheath to track more easily over the wire (Fig 3). Sometimes the Amplatz wire is too stiff to advance over a narrow-angle aortic bifurcation. In this situation, paradoxically, a less stiff wire, such as a Rosen wire, may advance and may still provide sufficient support to advance the sheath.

Step # 3: Advancing the sheath over the dilator. If a stiff wire still does not provide sufficient support to advance

Fig 3. Use of a stiff wire to open the aortic bifurcation.

the sheath, one may be successful by "walking" the sheath over the dilator a few centimeters at a time. In this technique, one unlocks the sheath from the dilator, advances the sheath 1 to 2 cm off the dilator (Fig 4), then readvances the obturator. Repeating this process may allow one to successfully advance the sheath over the aortic bifurcation in small increments.

Step # 4: Advancing the sheath over a balloon. Another technique utilizes a balloon to lead the sheath over the aortic bifurcation. The balloon will usually track easily over the wire because it is much less stiff than the obturator for the sheath, and therefore requires less splaying of the aortic bifurcation. However, when inflated, the balloon provides a smooth lead for the sheath. We recommend having an Amplatz wire in place, and we prefer to use a 4-mm × 4-cm balloon (Opta Pro; Cordis Corporation), advanced until it is just distal to the end of the sheath (after the obturator has been removed). The balloon is inflated, and then as it is deflated, the sheath is advanced over the deflating balloon (Fig 5). We have found this maneuver to be quite successful.

Step # 5: Snaring the wire technique. If the above techniques all fail, particularly in the presence of an aorto-bifemoral or aorto-bi-iliac bypass or stent graft, one may need to establish a through-and-through femorofemoral wire to successfully advance the sheath over the aortic or graft bifurcation. To do this, the IL CFA is now punctured, and a short sheath is inserted. Through this sheath, a wire is directed into the aorta or aortic graft proximal to the bifurcation. Over this wire, a 5 Fr-long sheath is inserted, and through this a snare (EN Snare, Merit Medical Systems, South Jordan, Utah) is inserted. Once the wire inserted through the original CL sheath is snared, it is pulled out through the IL sheath. Then, with tension on

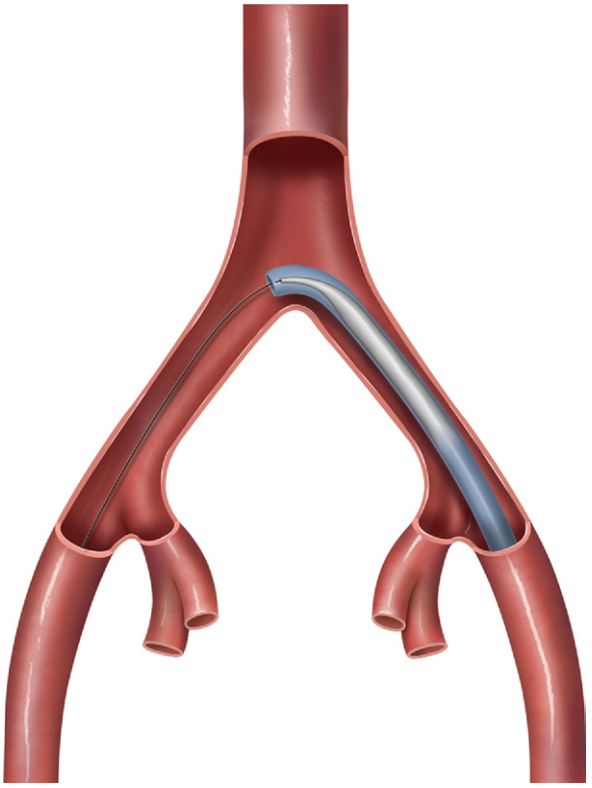

Fig 4. Advancing the sheath over the dilator.

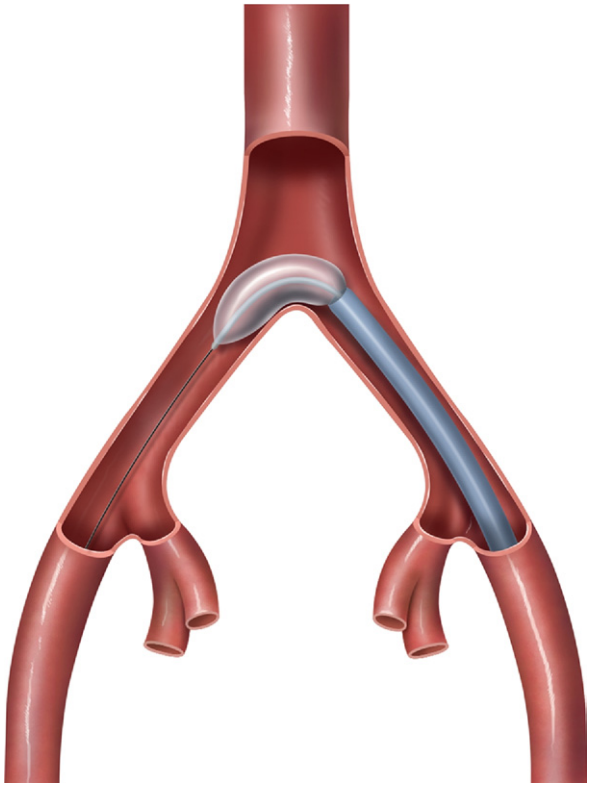

Fig 5. Advancing the sheath over a balloon.

this through-and-through wire, the long sheath is advanced over the aortic bifurcation, down to the level of the IL CFA. At this point, the through-and-through wire is pulled back into the IL CFA and then redirected into the IL artery that is the target for intervention.

When all else fails. When a retrograde approach fails, then either an IL antegrade approach or a brachial approach may be needed. The antegrade approach may not be feasible if the patient's body habitus is unfavorable (obese). The disadvantages of the brachial approach include the risk of stroke, and the length of the devices may not allow treating very distal lesions. Finally, a very sharp left subclavian artery angle with the aortic arch or a type 2 or 3 aortic arch may preclude successful access. The right subclavian artery is avoided because of the increased risk of stroke. In some circumstances, a retrograde approach from either the IL popliteal or tibial artery can be utilized. Finally, sometimes the simplest approach is a small incision to provide access to the IL common or superficial femoral artery.

CONCLUSIONS

The first step in any endovascular intervention is establishing appropriate arterial access. Specific anatomic features may make that step very challenging, threatening the success of the procedure. In this article, we have summarized some techniques that may help with difficult groin access and adverse aortic bifurcations. It is important to remember that not all aortic bifurcations can be crossed, particularly in the setting of a previous aortobifemoral reconstruction or bilateral iliac stents. However, by mastering a variety of technical approaches, the endovascular specialist will expand the applicability of and improve the outcomes of endovascular treatment.

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